

### Redesigned NIF Capsule Increases Viability of Ge-Doped CH as Ablator.

NIF ignition capsules have been designed with ablators of polyimide, beryllium, and doped CH. Of these three, the original material—doped CH—appeared in simulations to be the most susceptible to hydrodynamic instability growth. The original design was optimized for implosion margin, which emphasized high implosion velocity and left the target susceptible to short-wavelength instability growth. Improved calculational capability over the years since then has proven that the original design could only tolerate perturbations smaller than about 30-nm rms roughness. In contrast, more recent designs using polyimide can tolerate about 50-nm roughness, and beryllium about 60-nm, all at 1.3-MJ laser energy absorbed and nominal hohlraum coupling efficiency.

Because doped CH is probably the easiest material from which to fabricate the capsules, we have revisited the optimization of the doped CH capsules. The figure shows a full scan of the space of possible capsule dimensions, representing optimization of 333 different designs. The laser energy and hohlraum coupling

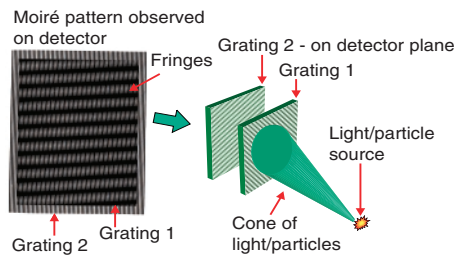
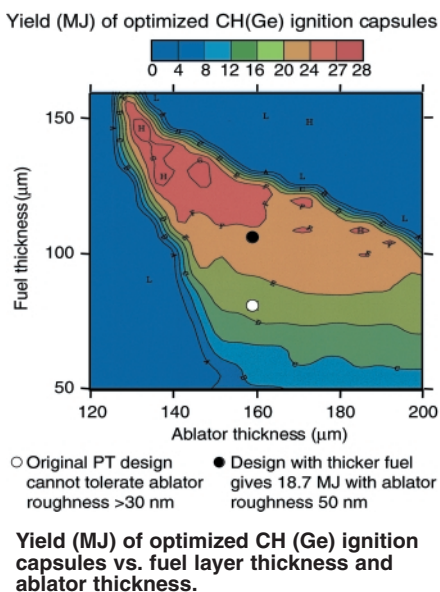
are held fixed in the scan over capsule dimensions. In order to scan the space completely and efficiently, a computer routine was written that automatically finds the optimal pulse shape for each design. The contours of 1D yield show the full operating space for these capsules, bounded by ablator burnthrough on the left and inadequate implosion velocity on the upper right. Two-dimensional simulations are in progress to find the optimum design that includes hydrodynamic instability growth. A first result is indicated: a target with thicker fuel can tolerate considerably larger perturbations than could the original design. Similar detailed optimization will be done for the polyimide and beryllium capsules.

### Sub-picosecond Proton Moiré Interferometry Demonstrated Using Laser-Produced MeV Proton Beams.

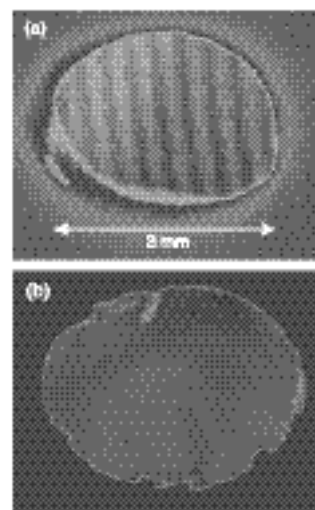
When light or particles pass through a pair of transmission gratings whose rulings are rotated with respect to each other, a series of Moiré fringes will be observed, as shown in Figure 1. The inclination of these fringes depends on the degree of collimation of the source, and this has been widely used in optics to measure the focal length of lenses. While diffraction theory must be used to analyze optical Moiré patterns, diffraction can be neglected for particles, allowing simple geometric considera-

tions to be used for interpretation of the proton Moiré patterns, greatly simplifying the analysis of experimental results.

Figure 2 shows images of a laser-generated proton beam obtained in a recent experiment carried out on the JanUSP laser at LLNL, in collaboration with physicists from V division and Queens University, Belfast. Proton Moiré fringes can clearly be seen in the location where the sub-picosecond pulse of 6-MeV protons has passed through the crossed transmission gratings. The orientation of the fringes was consistent with a point



**Figure 1. Experimental setup for proton Moiré demonstration and an example of expected result. The pitch of the Moiré fringes depends on the grating rotation angle, while the inclination of the fringes depends on the divergence of the source.**



**Figure 2. Images on film of a laser-generated proton beam produced by focusing the 100-fs JanUSP laser onto a thin target at an intensity of  $1 \times 10^{20}$  Wcm<sup>-2</sup>. (a) Image through transmission gratings and (b) image through hole in grating substrate.**

source of protons located within 2 mm of the 5-cm distant laser-irradiated target surface.

These experiments represent an essential proof-of-principle result because in a direct analogy with optical experiments, shifts in these Moiré fringes can be used to locally measure angular deflections in the proton beam. A quantitative measurement of these deflections may allow us to infer the magnitude of extremely large electric fields in plasmas with picosecond time resolution.